

5 Print Quality

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Initial Print Quality Troubleshooting Actions

For the vast majority of print quality problems, a Call Agent should request that the customer performs the troubleshooting actions in the *Maintenance and Troubleshooting Guide* in the section 'Troubleshooting print-quality issues'. Most problems can be resolved using these procedures without the need for an on-site visit.

How to Use the Image Quality Plots

The Printer contains a series of basic image quality tests which help you to diagnose image quality defects. There is an option to print all three diagnostic prints at once or print them individually.

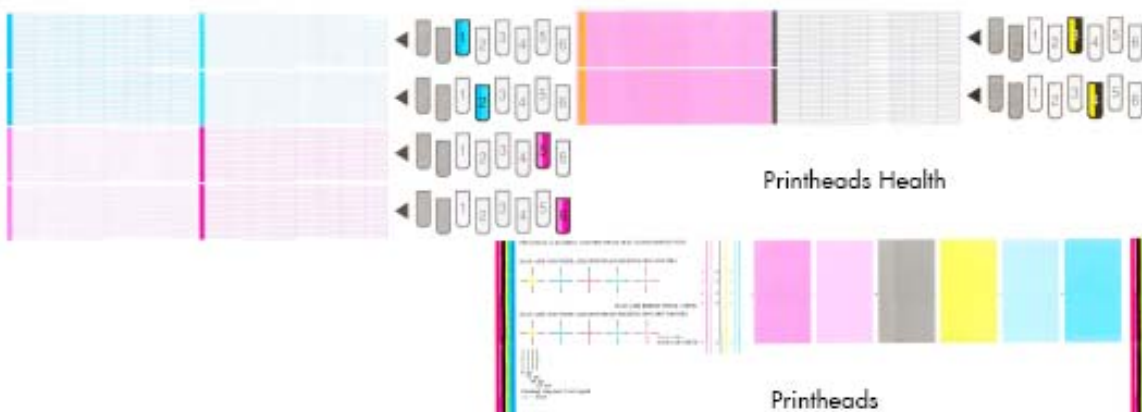
The three Image Quality plots test the printer in different ways, but can be split into the following sections:

- **Printhead Alignment:** The purpose of this test is to test the accuracy of the current printhead alignment.
- **Printheads Health:** This test is designed to check if the printhead nozzles print correctly.
- **Substrate Advance:** This test enables you to visually check if there are any substrate advance issues with the printer.

To print all the test diagnostic prints shown here go to the Service Menu List>2. Image Quality Plots> 2.1 Print ALL plots.

Considerations for Printing the Diagnostic Print

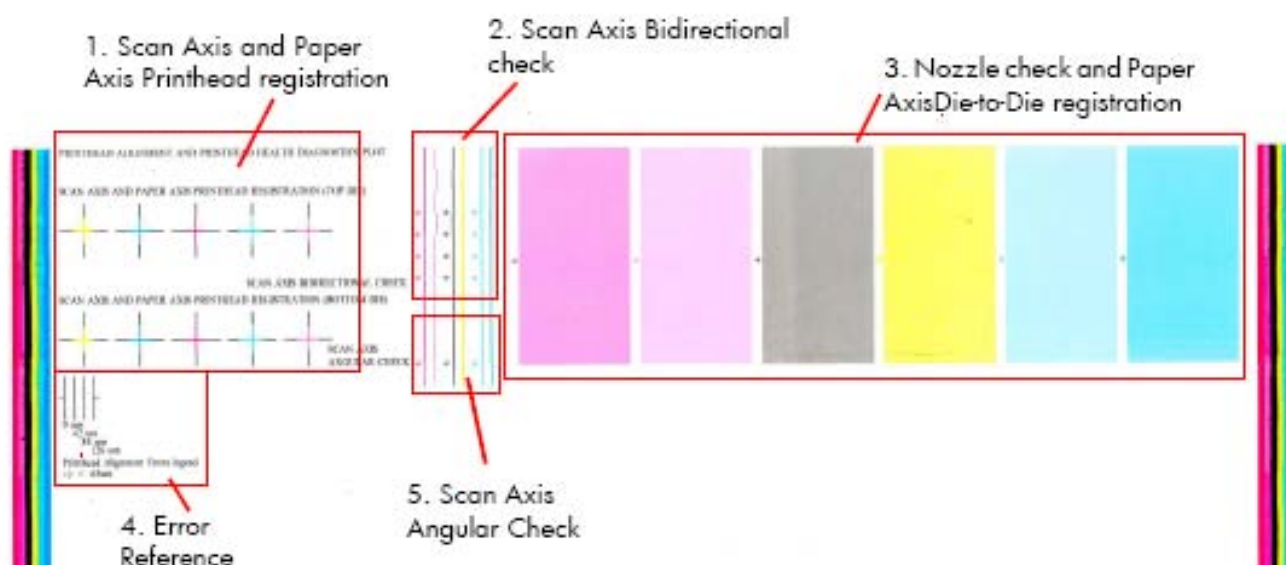
1. Use the same type of paper that the customer was using when they experienced the image quality problem.
2. If you do not see any problems with the Image Quality Test, then the problem may not be with the printer itself. The problem may be with the RIP.



2.2.1 Printhead Alignment Test Plot

To print this test plot go to Menu List>2. Image Quality Plots>2.2 PH Alignment Menu>2.2.1 Test Plot.

This test is designed to check the accuracy of the current printhead alignment. The plot consists of five different areas:

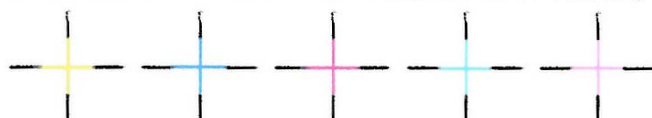


1. Scan Axis and Paper Axis Printhead registration

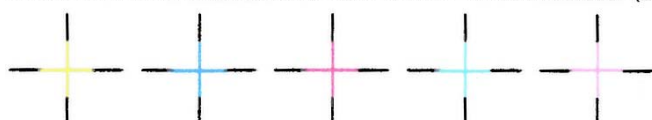
The colored crosses of the plot should show lines perfectly aligned with each other, as shown below.

The die 1 and die 2 of the black printhead is used as a reference to which the rest of the pens are compared. The substrate does not move while the pattern is being printed.

SCAN AXIS AND PAPER AXIS PRINTHEAD REGISTRATION (DIE 1)

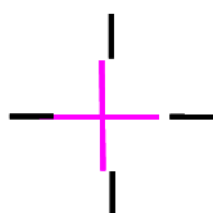


SCAN AXIS AND PAPER AXIS PRINTHEAD REGISTRATION (DIE 2)

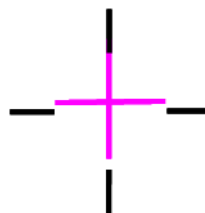


If the Printer is experiencing **horizontal** misalignment problems, the Alignment Test will print the lines in the orientation shown below (A). If the Printer is experiencing **vertical** misalignment problems, the Alignment Test will print the lines in the orientation shown below (B):

A



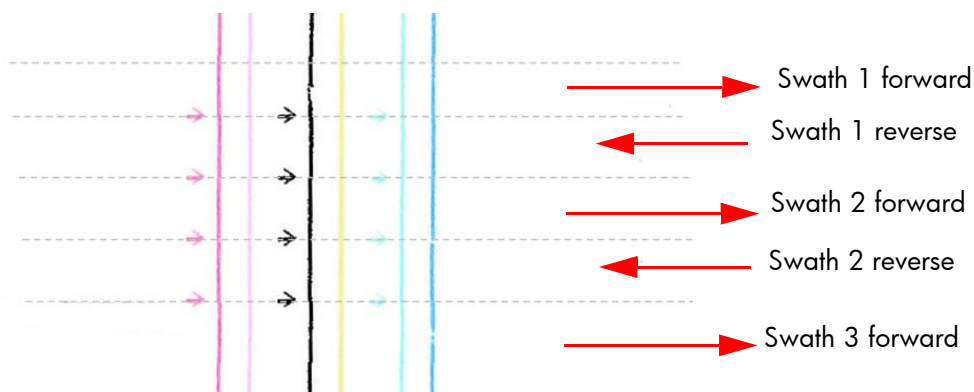
B



2. Scan Axis Bidirectional check

The small arrows point to the place where lines printed in forward and reverse directions meet. It is at this point that the registration accuracy must be checked.

The check should be done for the M-Lm, KY and C-Lc printheads. The bidirectional alignment can change slightly as the substrate thickness varies.

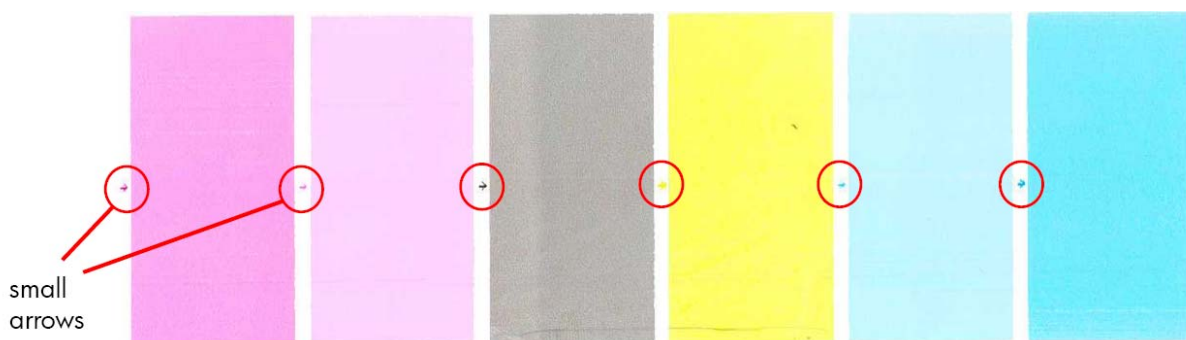


The plot should show lines perfectly aligned with each other, a straight vertical line indicates correct bidirectional alignment (A). If any of the printheads are experiencing bidirectional misalignment issues, the alignment test will print the lines as show below (B).



3. Nozzle check and Paper Axis Die to Die Registration

The colors are printed with a halftone, low-ink area fill, in a one pass printmode.



The small arrows point to the place where two different printhead dies meet. No significant light or dark lines should be seen at this point. Manual Alignment reset the alignment back to factory defaults.

The patches also provide a basic judgment about the printhead nozzle status. Horizontal bands indicate weak or missing nozzles.



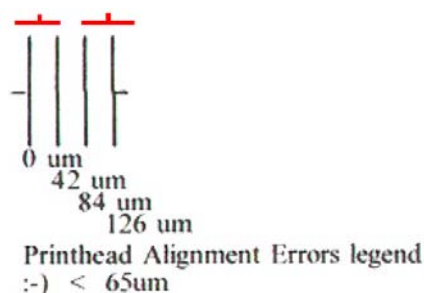
NOTE: If there are many horizontal bands indicating weak or missing nozzles, the die to die registration test will be a poor indicator of the status of the die to die registration. If this occurs clean the printheads and reprint the test.

4. Error reference

The plot contains a reference marked 'Legend', this is a guide to deciding if any of the printhead registrations are correct or incorrect.

- The correct/incorrect criteria shown here corresponds to a plot with a maximum IQ (usually printed on high quality substrate such as vinyl). Other substrates and usage may accept significantly worse registrations while still producing an acceptable level of image quality.
- Automatic printhead alignment may not produce optimal registration under certain conditions. Substrate texturing, elasticity and the behavior of the substrate under different temperatures may lead to some imperfections with regards to printhead registration. In these circumstances the user may choose to use the Manual Printhead Alignment instead.

Correct Incorrect

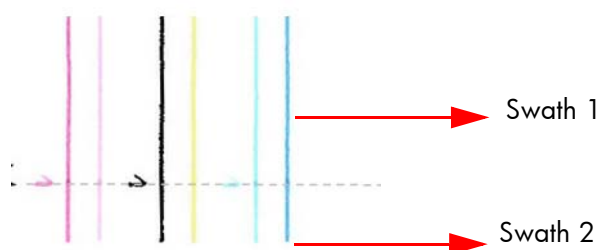


5. Scan Axis Angular Check

The small arrow point to the place where the lines printed in subsequent passes meet using unidirectional printmode. The registration must be checked at that point. The check should be done for the MLm, KY and CLc printheads. Note that the substrate advances between the upper and lower parts of the plot.

This test mainly relies on the changing surface of the substrate. Problems in the angular alignment lead to pen to pen misregistration. This is because of the staggered orientation of the printheads.

The angular alignment can differ slightly when the type of substrate varies, or when the substrate has recently been loaded.



Corrective Action

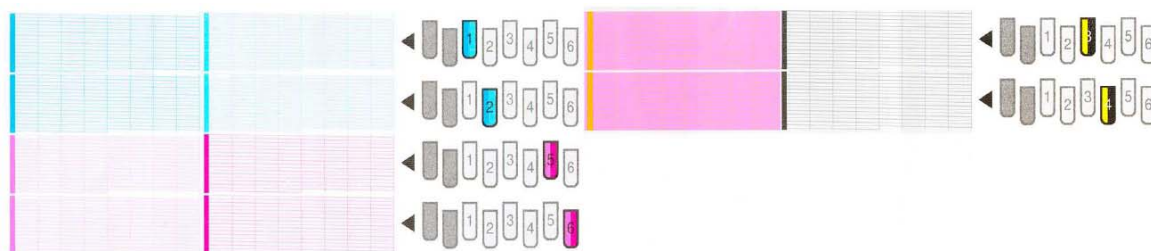
1. Perform a Printhead Alignment. Use the same type of paper that the customer was using when there were image quality printing issues. However it should be noted that some paper types are not suitable for the Printhead Alignment.

2.4.1 Printheads Health Test Plot

To print this test plot go to Menu List>2. Image Quality Plots>2.4 Printheads Health>2.4.1 Print Test Plot. The printhead health test plot is designed to enable you to see the overall health of the printhead nozzles.

The nozzles check (bottom of the plot) is printed in a one-pass full swath mode. The diagnostics test prints out every single nozzle of each Printhead without applying an error hiding or alignment algorithm.

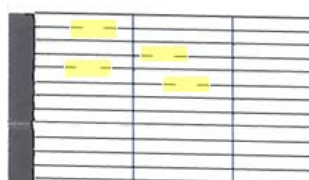
For each Printhead, you can see both the adjacent and the consecutive nozzles. For every Printhead there is a different horizontal band that can be identified with the help of the template marked with the colors of the Printhead used at the right of every band.



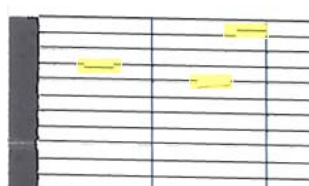
There are a series of numbered stepped diagonal lines. If one or more of the nozzles are malfunctioning or mis-positioned, you will see that the stepped lines are broken or misdirected in one or more places.



In this example of the plot the print shows a nozzles health pattern without any failing nozzles. In this case, the case shown corresponds to the black color.



This is an example of nozzles out. You can see the broken or the skewed line, in this case marked in yellow to help you to understand the issue. In the service plot there are no yellow marks.



This is an example of nozzles mis-positioned or malfunctioning. You can see the broken or the skewed line, in this case marked in yellow to help you to understand the issue. In the service plot there are no yellow marks.

For a more in-depth view of the health of the nozzles you can print the Advance Nozzles Health test plot.

Corrective Action

If the printer has nozzle defects, acceptable print quality results can still be achieved because the Printer can automatically compensate for this, there is no need to replace the Printhead because of nozzles out.

The method of improving Nozzle Defects is to:

1. To clean the printheads, go to the printer's front panel and select the ink menu, then Image quality maintenance > Clean printheads. Select which printheads you need to clean. You can clean all of the printheads or only some of them. The selections available are:
 - Clean all
 - Clean M-LM
 - Clean C-LC
 - Clean K-Y
2. Reprint the Printhead Nozzles Test Plot to verify that the defective nozzles have been corrected.
3. If the problem persists, replace the defective Printhead.

2.3.2 Substrate Advance Test Plot

Printing direction
(paper axis)



Left plot



Center plot



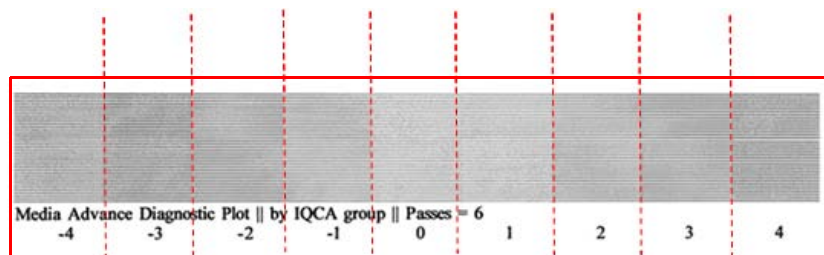
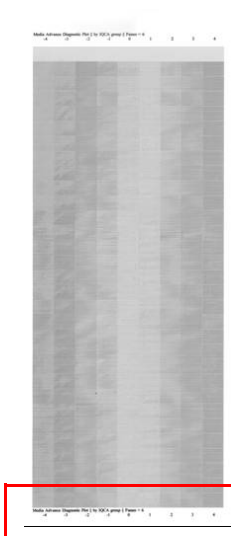
Right plot

To print this test plot go to Menu List>2. Image Quality Plots>2.3 Substrate Advance>2.3.2 Print Adjustment Plot.

The Substrate Advance Test Plot enables you to visually determine the accuracy of the media advance, if there are any advancement issues they will appear in this diagnostic plot.

The plot can be used to precisely measure the media advance error with a one dot row accuracy or 2.85mm per meter, and to verify the stability of the media advance. In addition, the test is performed on the left, center and right side of the scan axis. This is to verify any differential advance due to an uneven advancement of the substrate.

Each sample is composed of 9 vertical columns named -4 to 4. Each single column represents an advance deviation of 2.85mm per meter, so column -4 is related to a deviation of -11.42mm per meter and 4 corresponds to +11.42mm per meter. The advance obtained along the scan axis direction corresponds with the position of the lighter portion of the pattern in each advance, as shown on the next page.



A perfectly calibrated printer will show a straight vertical lighter line in the 0 column. If the lighter line is printed in any of the other columns, this would indicate there is a constant advance offset along the entire plot. If the offset is bigger than $\pm 2.95\text{mm}$ per meter (the lighter column is not the center one), this can be adjusted by using the button on the front panel to change the compensation of the substrate advance as the printer prints.

It is very important to verify that the substrate selected on the front panel, is the same as the actual substrate loaded on the printer. You can verify the substrate type selected through the Front Panel (Main Menu>Paper Menu>View Loaded paper). If an incorrect substrate is selected, this will produce an offset error in the Paper Advance.

Corrective Action

The figure shown here (left) shows a vertical lighter shaded line placed at column -3, which indicates an offset of 8.57mm per meter.

This can be adjusted by using the button on the front panel to change the parameters as the printer prints.

- If the lighter line is in the negative column, increase the compensation of the substrate advance.
- If the lighter line is in the positive column, decrease the compensation of the substrate advance.

When the lighter shaded line is in position 0, the process is complete.

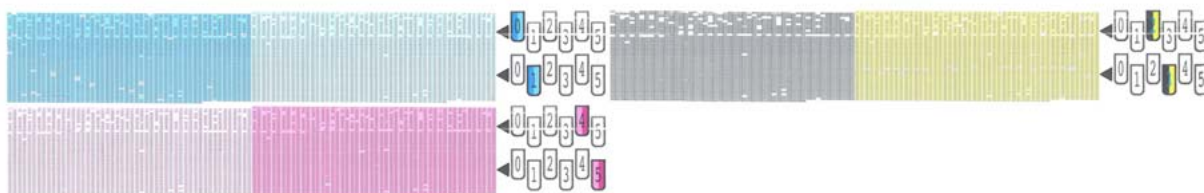
If the advance is not a straight line, this would indicate that the printer has a variable advance error.

If this is the case verify the following:

- Check to see if the OMAS is clean, if it is not clean the OMAS and reload the substrate and repeat the diagnostic plot.
- Check that the OMAS is functioning correctly. Check the light in the OMAS blinks while the substrate moves while an image is being printed.
- Check that the OMAS can function correctly with the type of substrate loaded. If it cannot, for example with high gloss substrate, disable the OMAS from the RIP and reprint the diagnostic plot.

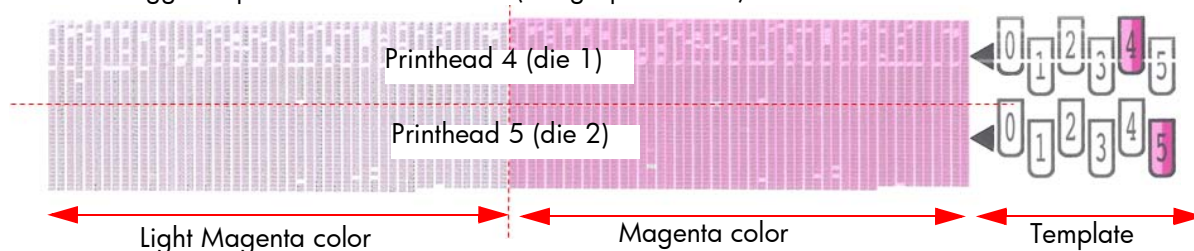
2.4.2 Advanced Printhead Health Test Plot

The Advanced Printhead Health Test Plot is not part of the large diagnostic print, but it is similar to the Printhead Health Test Plot described previously. With this plot however you will be able to identify which of the Printhead Nozzles is actually failing. To print this test plot go to Menu List>2. Image Quality Plots>2.4 Printheads Health>2.4.2 Advanced Test Plot.

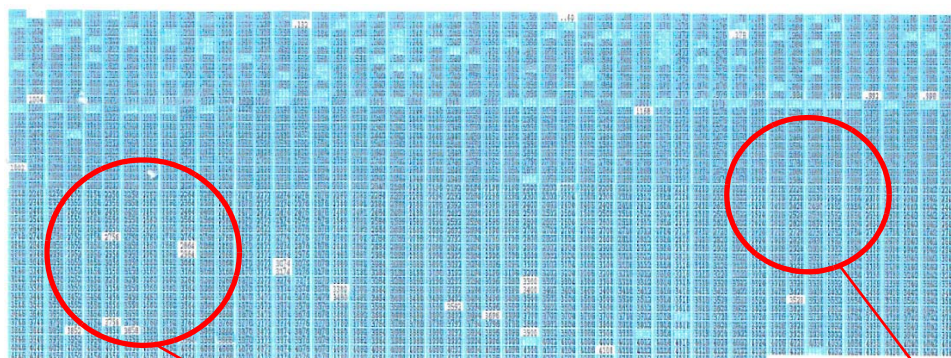


This plot, like the normal nozzles health test, prints in a special one-pass full swath mode, but unlike the normal nozzle health test, only a few of the nozzles are printed at once and with small incremental media advances. Eventually all the nozzles of all the printheads are printed, this means printing the plot can take longer than the normal health test.

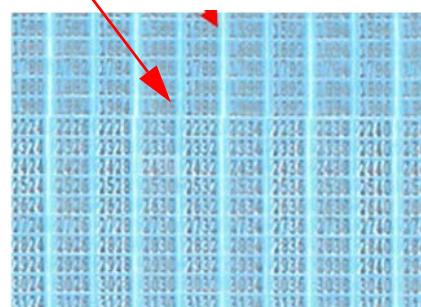
The plot is intended for visual inspection only. The plot consists of three blocks. For each printhead, there is a different block, which can be easily identified by the colors of the printhead used inside and/or the template located on the right side. Each block is split horizontally into two areas that correspond to the colors in the printhead. Vertically, the block is split into sections that correspond to two dies combining the two staggered printhead of each color (see graphic below).



Each single region is composed of a series of numbered triangles. Each rectangle is related to a single nozzle in the printhead. If one or more of the nozzles are malfunctioning or mispositioned, you will see that the rectangles are not filled. The corresponding color and the number printed inside can be read.



This example on the left has many nozzle outs. The unfilled white rectangles indicate the nozzle is not firing. In this example, the zoomed area has 6 faulty nozzles. The corresponding nozzle number can be seen directly from the print.



This is an example of good nozzle health. All rectangles are perfectly filled with the printhead's color.

Corrective action

If the printer has nozzle defects, the level of image quality achieved can still be considered acceptable because the Printer can automatically compensate for this, there is no need to replace the Printhead because of nozzles out.

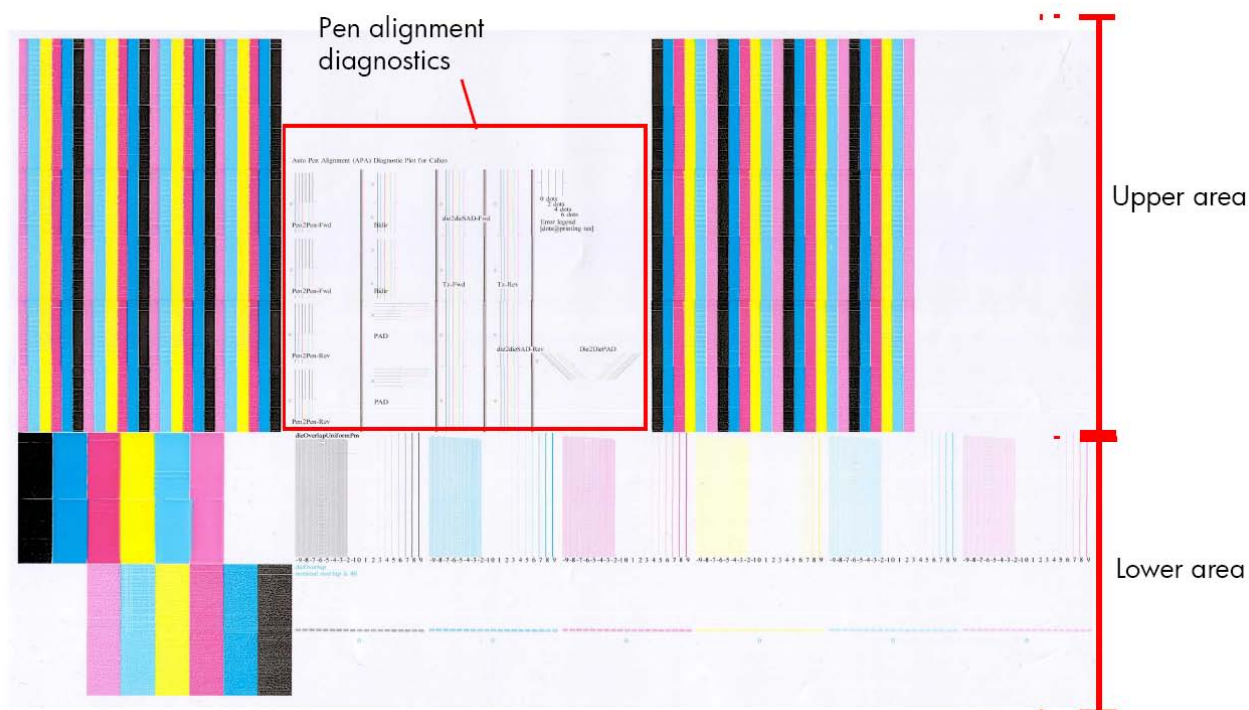
A single die for a single color can contain up to 70 nozzles out and still the print quality will not be significant degraded.

1. Perform a clean of the printheads
2. If there is still any die above the threshold level (70 nozzles out), perform a hard clean process.
3. If the a hard clean has improved the number of nozzle that have been recovered, perform the hard clean again.
4. If there are any dies that have more than 70 nozzles out per die, replace the printhead.

2.2.2 Advanced Alignment Diagnostic Print

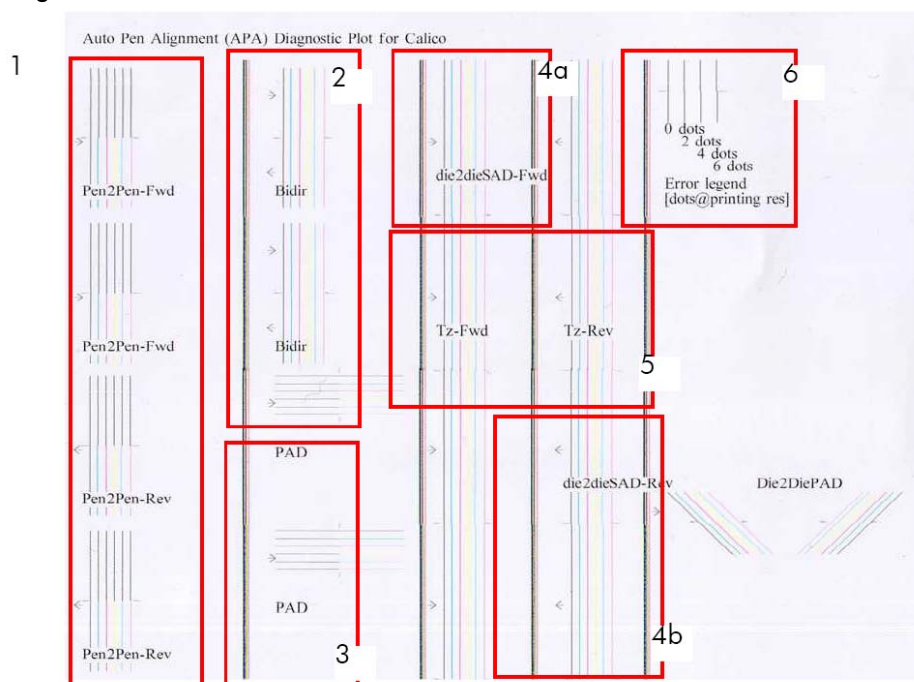
This plot helps you to visually check any alignment problems of the printer, it is similar to the process already described on ⇒ Page229, but in more detail. You use it to precisely measure the alignment error with a one dot row accuracy. To print this test plot go to Menu List>2. Image Quality Plots>2.2 PH Alignment Menu>2.2.2 Advanced Test Plot

The plot is split into two main areas. The upper area contains the area which checks the pen alignment, while the bottom area checks the same color staggered pen overlap.



Pen Alignment Diagnostics

The Pen alignment Diagnostics, shown in the red box above, consists of various areas to check the alignment:



1. In this area there are four checks for the pen to pen alignment in the scan axis direction (Pen2Pen-Fwd or Pen2Pen-Rev). It is forward and reverse.
 - The top pattern is related to the front printhead (nearest to the user when doing the pen replacement).
 - The bottom pattern is related to the rear printhead (furthest from the user when doing the pen replacement).

The area to check is the junction (marked with a "-") of the black with the rest of colors.
2. The bidirectional check is at the top, marked as Bidir.
 - a. The top pattern is related to the front printhead (nearest to the user when doing the pen replacement).
 - b. The bottom pattern is related to the rear printhead (furthest from the user when doing the pen replacement).

Check that the lines are continuous without a gap. The junction is marked with a "-"
3. The pen to pen alignment in paper advance direction (PAD) is marked as number 3.
 - a. The top pattern is related to the front printhead (nearest to the user when doing the pen replacement).
 - b. The bottom pattern is related to the rear printhead (furthest from the user when doing the pen replacement).

The area to check is the junction (marked with a "-") of the black with the rest of colors.
4. The alignment in the scan axis direction between both printheads of the same color is marked as 4a (in forward direction die2dieSAD-Fwd) and 4b (in reverse direction die2dieSAD-Rev).

The area to check is the junction (marked with a "-"). The lines have to be continuous.
5. The ThetaZ of the printhead are checked in the area marked as 5. It checks in forward (Tz-Fwd) and reverse direction (Tz-Rev).

The area to check is the junction (marked with a "-"). The lines have to be continuous.
6. The area marked as number 6 is a reference legend that shows junction misalignments of 2, 4 and 6 dots. The junction to check has to be below 4 in all the cases. If the error seems to be above 4 dots, then realign the printheads again.

Die Overlap Alignment.

The Die Overlap alignment is at the bottom of the plot. The area to check is only the bottom junction pattern for all the colors. The clearest band must be around the 0 (± 3 dots). Every band is equal to a one dot error.



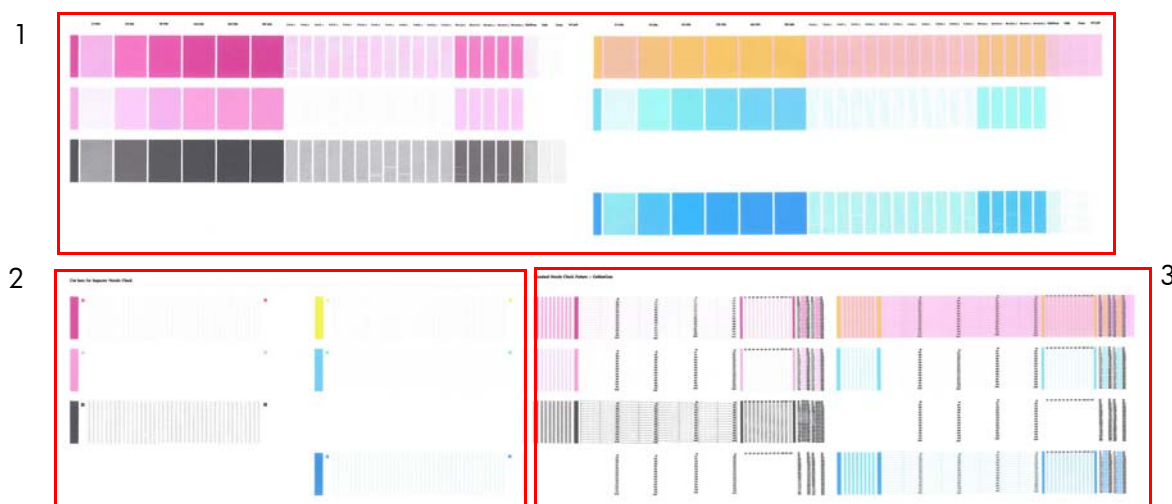
Corrective action

In order to solve any problem in the alignment, perform the following:

- Repeat the printhead alignment. Most recommended papers are glossy papers where pen alignment accuracy is best. There are some paper types that are not suitable for Printhead Alignment (transparent, translucent).
- Try cleaning the Printheads if the error continues.
- If the error persists, replace the affected printhead.
- If there is an issue in the ThetaZ and it cannot be fixed, check if the paper is working with the OMAS sensor. There are some papers that cannot be controlled by the OMAS sensor. If the paper is a type that should work with the OMAS sensor, check the functionality of the sensor.

2.4.3 Plot for escalation only

To print this test plot go to Menu List>2. Image Quality Plots>2.4 Printheads Health>2.4.3 Only For Escalations. There are two identical plots to this test and each plot has three parts to it. The first plot refers to the rear printheads (number 1, 3, 5), while the second plot refers to the front printheads (2, 4, 6).



This plot is only printed at the request of the HP Division, or in case further help is required and there is need to escalate an image quality issue to HP Division.

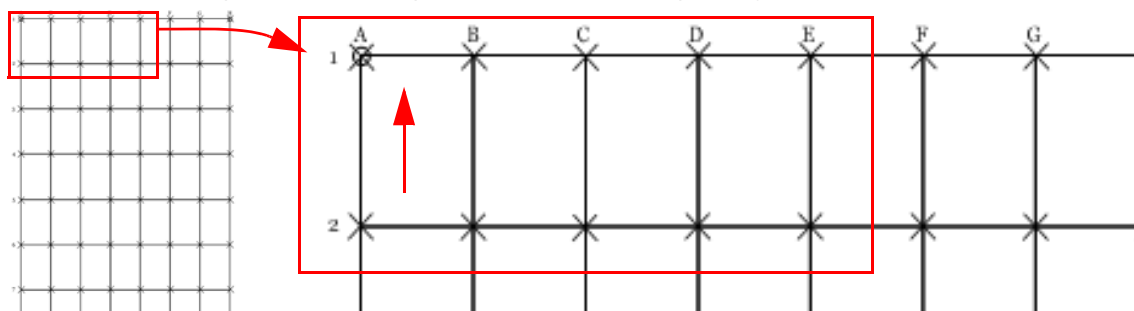
2.5 Geometry Check

The Geometry check print test is a simple template designed to check the printer's length accuracy and figure distortion performance. To print this test plot go to Menu List>2. Image Quality Plots>2.5 Geometry Check.

If a customer complains that there is an issue with a plot they are printing, this standard template can be printed and referred to by both the customer and HP as a single point of reference.

The plot consists of a 7x7 matrix of rectangular boxes. By default, each single rectangle corresponds to a DIN A4 sheet size (210mm x 297). Based on this, the total printed plot length should be about 2.07 meter (approx. 82") and 1.47 meters (approx. 58"). However the actual dimensions will highly depend on what settings have been defined for the Media Advance.

Each point in the matrix can be identified by means of a letter in the X axis and number in the Y axis. There is an arrow in the plot close to the point 'A1' to show the printing direction.



The method of evaluating the geometric performance is the following:

1. Select an area on the matrix to evaluate for accuracy and dimensional integrity. The template is designed so you can measure anything from an A4 sheet upwards to any probable dimension.
2. Place the printed plot on a flat surface. This will minimize any wrinkles before proceeding with the process.

- Find the vector length accuracy by selecting parallel vectors and/or figure distortion by measuring the diagonals in the selected area.
- Note the measurements to assess the printer's performance. It will help to keep the measured vectors identified by using the name convention marked on the plot i.e. A1, A3. This makes it easier to identify exactly the areas of the plot where the measurements were taken.



NOTE: To check if a printer complies with the technical specifications, please refer to 'Line accuracy' section in the printer's data sheet.

NOTE: After loading media, allow the media to stabilize before printing the plot. Some types of media require up to 3 meters before it is stabilized.

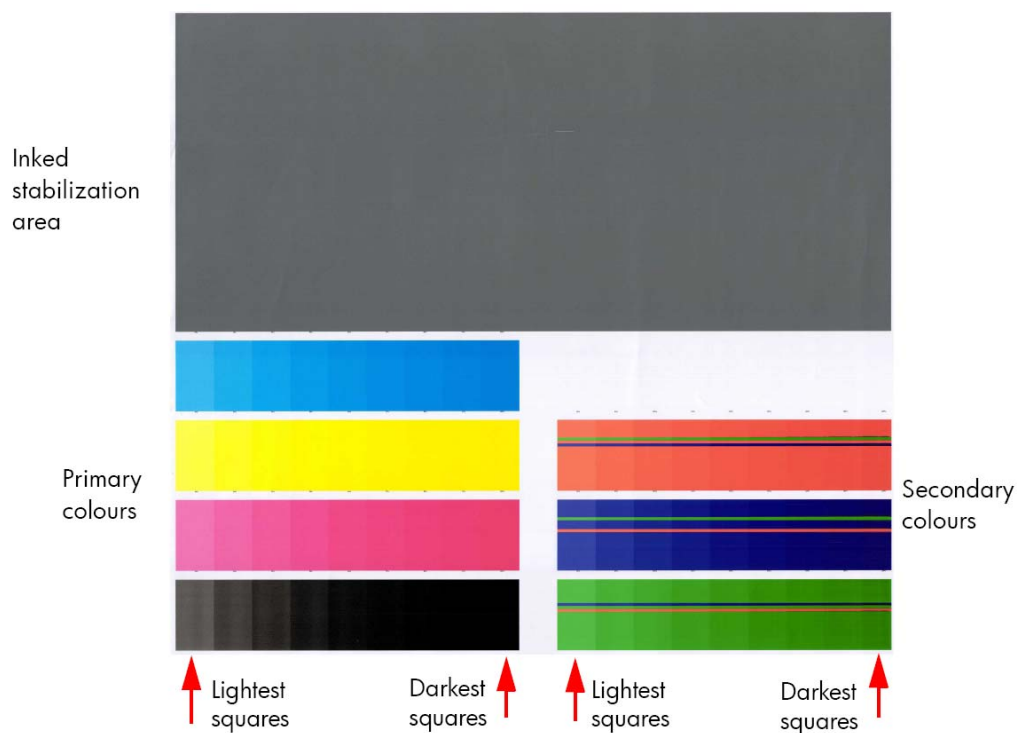
Corrective Action

- Reload the media following the exact steps from the User's Manual.
- In some cases, differences in the media advance along the scan axis could cause geometric defects. Try adjusting the settings in the RIP. Adjust Vacuum level and Backtension levels. Be careful when adjusting these settings, refer to the RIP supporting documentation for further details of this type of adjustment.

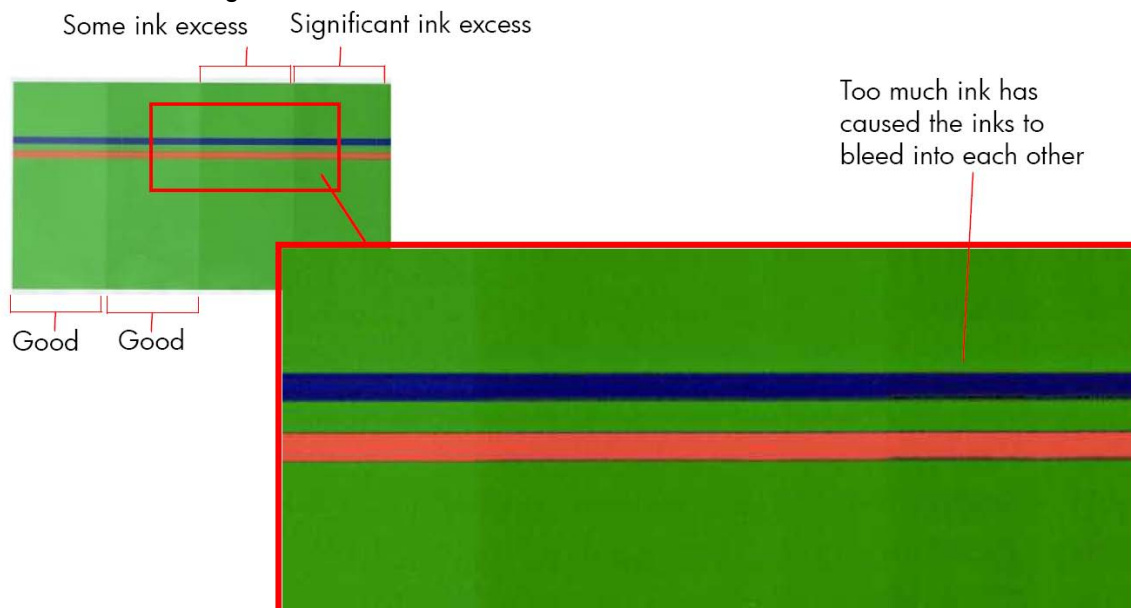
3.1 Inks on Substrate Test

The Inks on Substrate Test plot is used to determine the level of performance of the Drying and Curing Assemblies and to determine if they are performing as expected. To print this test plot go to Menu List>3. Inks On Substrate Test>3.1 Print Ink Test Plot.

At the beginning of the plot is an area used to stabilize the printing system before the diagnostic print is printed, this area can be ignored. The diagnostic area of the print contains colored blocks representing each of the primary and secondary colors, the plot shows a scale from lighter to darker intensity (amount of ink). The plot is printed with a 10 pass print mode.



To evaluate the **Drying** test plot look at the last square (in order of increasing ink quantity) that shows no coalescence, banding or bleed effects.



To evaluate the **Curing** test plot look at the squares that show ink smudge when touched (see picture) or that show an 'oily finish' (which is more likely).

The following table shows the maximum quantity of ink (the darkest patch) that can be printed using **HP Permanent Gloss Adhesive Vinyl** without producing any of the issues previously stated. The evaluation is performed in the secondary colors only:

Color	Coalescence	Bleed	Curing defects
R	200%	116%	200%
G	100%	116%	200%
B	100%	116%	200%

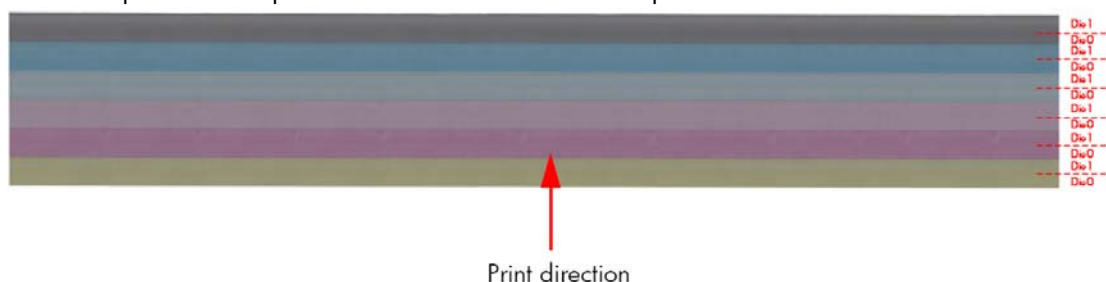
Corrective Action

At the bottom of edge of each block of primary color, and at the top of each secondary color, there is a percentage scale which indicates the level of ink used to print that portion of the diagnostic print. This information can be used to adjust the ink saturation levels in the RIP used by the customer.

2.6 Scan Axis check

This plot shows any defect in the Encoder Strip along the Scan Axis. To print this test plot go to Menu List>2. Image Quality Plot>2.6 Scan Axis Check.

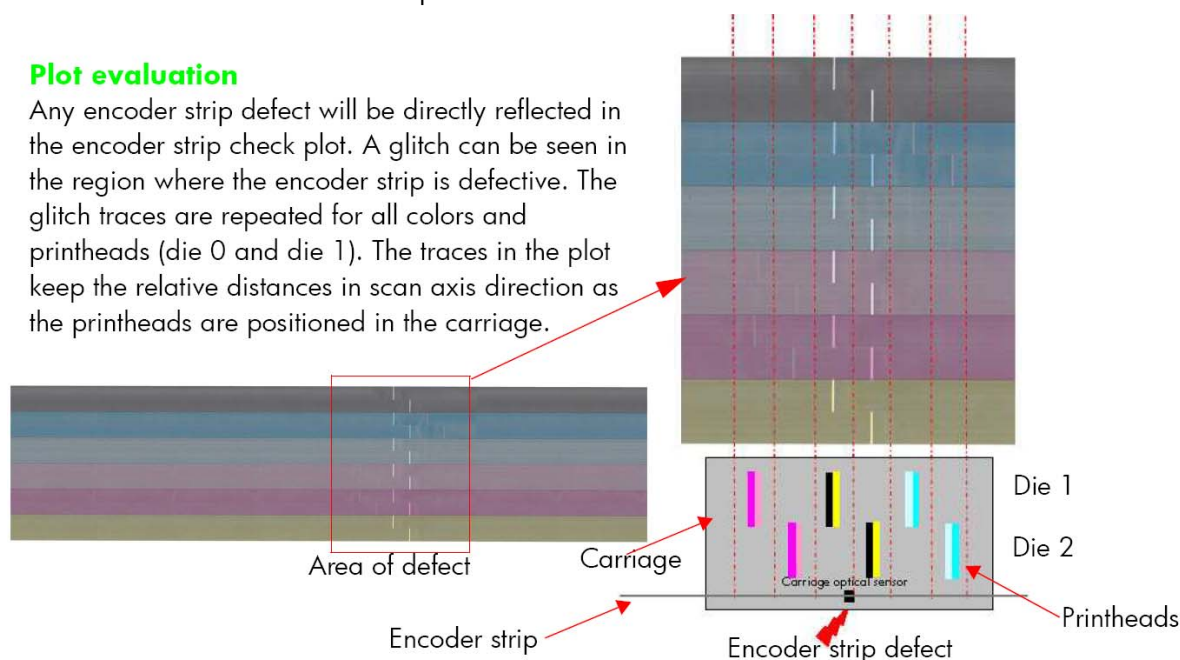
Any defects in the encoder strip will have a detrimental affect on the image quality of the printer, specifically in the area where the encoder is defective. The defect is revealed by means of an interference or Vernier pattern that spans the whole Scan Axis of the printer.



The test plot consists of six horizontal color bands with a black pattern mask on top of them. Each band is split in to two horizontal areas corresponding to the die 0 and die 1 for the specific color. The plot is printed in unidirectional mode at 40ips.

Plot evaluation

Any encoder strip defect will be directly reflected in the encoder strip check plot. A glitch can be seen in the region where the encoder strip is defective. The glitch traces are repeated for all colors and printheads (die 0 and die 1). The traces in the plot keep the relative distances in scan axis direction as the printheads are positioned in the carriage.



Corrective action

If an fault is found with the encoder strip, replace the Encoder Strip ⇒ page 399.

Force Drop Detection

If the Printhead Health test plot (⇒ page 231) has persistent white point banding in only one color that cannot be fixed with a recovery, you can use this option to resolve the problem by resetting the nozzle health data base so that all nozzles are assumed to be correct. After the nozzle health data base has been reset, the drop detection procedure is started ⇒ page 192.

The normal cause of this white point banding in a single color is the failure of the drop detector to correctly detect nozzles pot on the printhead.

This tool is also helpful to diagnose a potential failure of the drop detector. The 'force drop detector tool' displays the number of nozzles out per printhead. If you print the diagnostic plot image, afterwards you will be able to compare this number detected by the drop detector with the real number of nozzles out that you see on the printout.

If there is a mismatch on all the colors, this would probably indicate that the drop detector is not working correctly or is mispositioned. Before replacing the drop detector, perform a 'drop detector calibration' ⇒ (page 216) to correctly position it. If the failure (miss-match) is still there after the calibration, replace the drop detector.

Substrate advance issues

The vast majority of issues concerning the advancement of the substrate can be solved by asking the customer to clean the 'Substrate-advance sensor window'. This procedure is described in the customer document 'Maintenance and Troubleshooting Guide'.

If after performing this, the customer is still experiencing image quality issues related to the advancement of the media, use the following procedure.

1. Make sure the window of the OMAS sensor located in the Platen has been completely cleaned of all ink, the cleaning swabs provided to perform this procedure must be used.
2. Some types of substrate cannot be used with the OMAS sensor, because they are too smooth or there is too much light reflected from the substrate surface to be able to be read by the OMAS, examples of these types of substrate are: Clear Film, Backlit, types of Matte film, types of Polypropylene. Check the troubleshooting procedure on the next page to determine if the error is with the OMAS or the Substrate being used. If the error is with the substrate, there are two options:
 - Change the type of substrate to a type that can be used with the OMAS, ideally it will be a substrate with a readable surface, such as a self adhesive media, the type with a removal backing.
 - Disable the OMAS, and use the analog device to control the substrate advancement.
 - To disable OMAS, go to Service Test Menu > 1.3 Media Path Menu > 1.3.3 Enable/Disable OMAS. Refer ⇒ Page 189
 - Perform the Substrate Advance Calibration select the (ink) icon on the Front Panel, and then select 'Image quality maintenance > Substrate Advance calibration > Print adjustment plot, refer to the Maintenance and Troubleshooting guide.
3. Perform the 'OMAS Sensor Check' to check the electrical functionality of the OMAS ⇒ Page 189.
If the OMAS Sensor fails the check, replace the OMAS Sensor ⇒ Page 424.
4. Perform the 'TOMAS Sensor Check' to check the electrical functionality of the TOMAS ⇒ Page 189.
If the TOMAS Sensor fails the check, replace the TOMAS Sensor ⇒ Page 424.

Advance error with the Substrate or with OMAS?

^a List of types of media which are NOT used (non navigable) by the OMAS media sensor:

HP or HP Approved Clear Film

HP or HP Approved Backlit

HP or HP Approved types of Matt film

HP or HP Approved types of Polypropylene

A non HP or HP Approved Media

^b In order to perform this Calibration, you should order the Paper Advance Calibration Kit (Part Number Q1273-60296) which contains two cut sheets of HP Universal Instant-dry Gloss Photo media (36-inches wide by 42-inches long).

^c 'OMAS Blinking' means that the red LED in the OMAS lens blinks ON/OFF during paper advance when OMAS is operating.

